



Sudhir Sastry, left, Gonul Kaletunc, and Ahmed Yousef (not pictured) believe that using gaseous (not liquid) sanitizers will keep leafy greens safer from disease-causing pathogens.

Everyone knows that a new sanitizing technology is necessary. This research will benefit growers of leafy greens nationwide — but the fact that this work is being done in Ohio gives us a competitive advantage. And it works hand-in-hand with the development of the Ohio Produce Marketing Agreement, a collaborative food-safety standards effort between the Ohio Department of Agriculture, the Ohio Produce Growers and Marketers Association, and Ohio State.”

— Bobby Jones, *The Chef's Garden, Huron*

THE ESSENTIALS

If the food industry uses better techniques to make food safer, will consumers pay for it? An OARDC scientist suggests they might.

Using a new approach for willingness to pay estimates, agricultural economist Brian Roe determined Americans would be willing to pay about one dollar per person each year, or an estimated \$305 million in the aggregate, for safer food.

There is a limit: If a treated product cost only 10 cents more than an untreated package, about 60 percent of respondents said they would buy the improved product. But when the higher price reached \$1.60 more per package, less than a third would opt for the treated product.

More: <http://go.osu.edu/Esk>

Research Leads to Safer Food

Foodborne illness kills about 3,000 Americans and costs the United States \$152 billion annually. Although raw leafy greens are among the riskiest foods, that could change thanks to Ohio Agricultural Research and Development Center research.

“Leafy greens are porous. That porosity makes it easy for pathogens to enter the leaf,” said microbiologist Ahmed Yousef.

Currently, processors use liquid sanitizers on greens before packaging.

“But research shows liquid sanitizers are not always effective, and sometimes make the problem worse,” said food engineer Gonul Kaletunc. Air pockets can prevent the liquid from ever reaching portions of the leaf surface; when it does, it may not penetrate the leaf deep enough to reach microbes.

Yousef, Kaletunc, and fellow food engineer Sudhir Sastry are testing more effective gaseous sanitizers — ozone and chlorine dioxide — and determining when it would be best to use them: perhaps during vacuum cooling or possibly during transport.

“If we apply the right techniques in the right place at the right time, we really can improve the safety of produce,” Sastry said.

More: <http://go.osu.edu/leafy>



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- Some 230 scientists conducting more than 400 research projects annually.

OHIO AGRICULTURAL RESEARCH AND DEVELOPMENT CENTER

As the research arm of The Ohio State University's College of Food, Agricultural, and Environmental Sciences (CFAES), the Ohio Agricultural Research and Development Center (OARDC) employs nearly 650 scientists and staff members throughout the state, conducting research that benefits all Ohioans. OARDC's Wooster campus is the largest agbioscience research facility in the United States, and OARDC scientists work closely with researchers in Ohio State's Colleges of Education and Human Ecology, Medicine and Public Health, Veterinary Medicine, Biological Sciences, and Engineering. Research support is provided in three signature areas:

- **Advanced Bioenergy and Biobased Products**
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For more information, see the CFAES Strategic Plan at <http://go.osu.edu/GQ5>.

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Anastasia Vlasova and Kuldeep Chattha investigate how vitamin A might enhance vaccinations against rotavirus, which annually causes more than a half-million children's deaths worldwide.

Dr. Saif's work on the potential links between vitamin A and the effectiveness of the rotavirus vaccine is vital because if such a link is established, supplementation of existing rotavirus vaccines with vitamin A will provide an immediate and cost-effective strategy to increase the effectiveness of the rotavirus vaccine in the world's most vulnerable populations."

— Doug Watson, research scientist, Center for Advanced Drug Research, SRI International, Silicon Valley

THE ESSENTIALS

- In 2011, four researchers garnered \$1.35 million to participate in the multi-state project focused on foodborne illness from noroviruses. One of those researchers, Jianrong Li, earlier captured a \$1 million grant for studying norovirus in fresh produce. In another project, he is making headway on a vaccine against norovirus.
- In Linda Saif's lab, researchers Anastasia Vlasova and Kuldeep Chattha are unraveling why rotavirus vaccines fail more than half the time in developing countries. They suspect it's due to chronic vitamin A deficiency, and, thanks in part to funding by the National Institutes of Health, are testing whether giving vitamin A supplements with the rotavirus vaccine would increase its effectiveness. So far, results are mixed. The team is expanding its scope, including supplementing mothers with vitamin A while pregnant or breastfeeding.

Going Viral: OARDC Scientists Gain Recognition in Fighting Virus-Related Diseases

Rotavirus is the leading cause of severe diarrhea in infants and young children worldwide. Globally, it causes more than a half-million deaths each year in children younger than five years of age. In the United States, direct medical costs from rotavirus are estimated to reach up to \$385 million annually.

Norovirus causes more than 21 million cases of acute gastroenteritis each year in the United States alone. The Centers for Disease Control and Prevention estimates that more than half of all foodborne disease outbreaks are due to norovirus.

The Ohio Agricultural Research and Development Center is a global leader in combating these viruses, with researchers from Food Science and Technology and the Food Animal Health Research Program armed for attack. Leaders such as Linda Saif, elected a member of the National Academy of Sciences (NAS) for her achievements in viral research, join with other collaborators to track how viruses are transmitted through water, the environment, and the food chain in order to find new ways to inactivate viruses or prevent them from causing disease.

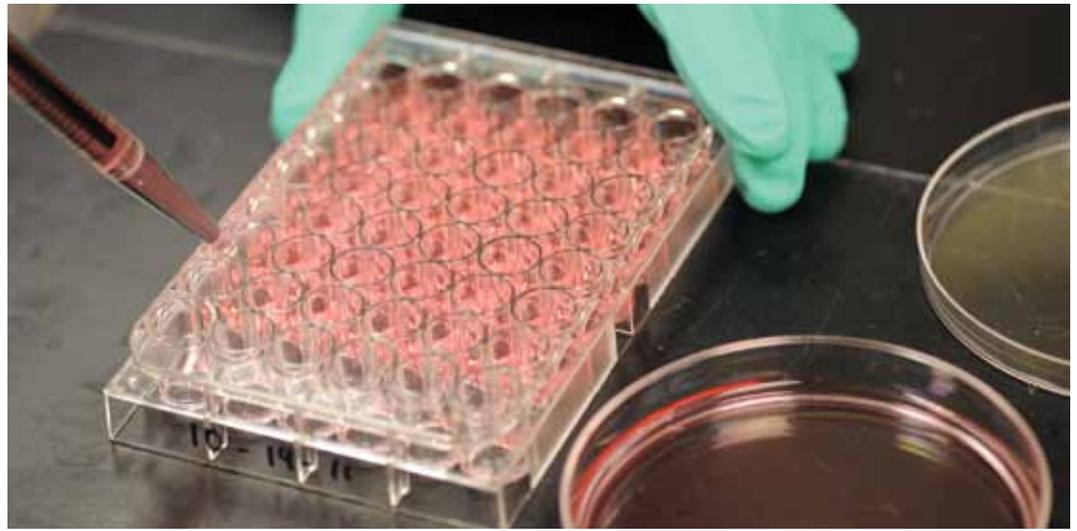
More: <http://go.osu.edu/GVB> and <http://go.osu.edu/virusgrant>



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Leah McHale leads OARDC's Soybean Breeding Program, whose new non-GMO varieties, for example, can earn a 1,000-acre Ohio farm up to \$96,000 more annually.

A soybean breeding program such as the one led by Leah McHale at OARDC can provide short- and long-term benefits to Ohio soybean farmers. Through the development of new varieties and incorporating pest and disease resistance in soybeans, Dr. McHale is directly impacting the future profitability of Ohio soybean farmers.”

— Tom Fontana, director,
New Use Development,
Ohio Soybean Council

THE ESSENTIALS

- Thanks to price premiums and new OARDC varieties, non-GMO soybeans add an extra \$32–64 million a year to Ohio's economy.
- Why the price premiums? Because of strong demand for non-GMO soybeans in European and Asian markets.
- On a farm of 1,000 acres, non-GMO soybeans can mean \$48,000–96,000 more every year in the farmer's pocket.
- OARDC's latest new variety, a non-GMO type called Summit, which is specially suited to northern Ohio, yields 2.4 bushels more per acre than a similar predecessor. To a farmer, say, in Lucas County, switching to Summit on 1,000 acres would be worth \$31,200–33,600 more every year.

Program Serves a Growing Niche: Non-GMO Soybeans Add \$32M Extra to Ohio's Economy

The Ohio Agricultural Research and Development Center's soybean breeding program fills a small but growing and valuable niche that industry tends to ignore — developing new non-GMO soybean varieties. (GMO stands for genetically modified organism.) Soybeans grown from non-GMO varieties are demanded by many of Ohio's export markets, sell at a premium price, and can boost a farm's profitability.

Thanks in big part to OARDC's program, which continually improves soybean varieties and makes the seed available to farmers, Ohio grows more non-GMO soybeans than any other state. About 15 percent of Ohio's 4.5 million acres of soybeans are non-GMO types — ones that come from traditional breeding.

Based on an example yield of 48 bushels an acre, a price of \$12 a bushel, and a non-GMO premium of \$1–2 a bushel, non-GMO soybeans bring an extra \$32–64 million every year to Ohio farmers' wallets and the state's economy.

More: <http://go.osu.edu/GQ3>



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OARDC researchers, such as entomologist Joe Kovach (third from left), have a long history of collaborating with faculty and students at Tanzania's Sokoine University of Agriculture.

iAGRI is helping our scholars acquire urgently needed skills and to produce the information and technology needed to respond to dramatic changes in our food system. We are happy that the Tanzanian graduate students who study in the U.S. under iAGRI will be exposed to the American land-grant university model, which attempts to close the gap between the laboratory and the real world. This project will help spring a 'green revolution' in agriculture in Tanzania."

— Benjamin Tiisekwa, dean,
Faculty of Agriculture, Sokoine
University of Agriculture

THE ESSENTIALS

A centerpiece project of USAID's recently launched Feed-the-Future initiative in Tanzania, iAGRI will:

- Train Tanzanian graduate students to strengthen that country's capacity to generate scientific and technological responses to agricultural productivity and food security.
- Address growing private-sector needs in food production, processing, marketing, and distribution.
- Strengthen the capacity of Sokoine University of Agriculture to develop and implement instructional, internship, and outreach programs in agriculture.
- Develop solutions to challenges facing food producers that are also applicable to Ohio and the rest of the United States.

Land Grant to the World: OARDC Involved in Vital Food Security Work in Tanzania

A world-class institution in a global age, the Ohio Agricultural Research and Development Center's work and impact often transcend the borders of Ohio and the United States. Such leadership is evidenced by the U.S. Agency for International Development's selection of OARDC in 2011 to lead the Innovative Agricultural Research Initiative (iAGRI). Headed by Mark Erbaugh, director of the university's International Programs in Agriculture, the \$24 million, 5-year project aims to improve agricultural productivity and food security in the East African nation of Tanzania — a country of 42 million largely dependent on agriculture and where half of the population lives in poverty.

Michigan State University, Tuskegee University, the University of Florida, Virginia Tech, and Iowa State University complete the consortium involved in iAGRI, which will endeavor to boost the training and research capabilities of Tanzania's Ministry of Agriculture, Food Security and Cooperatives as well as Sokoine University of Agriculture, following the U.S. land-grant model.

OARDC has more than 10 years of experience in agricultural research in Tanzania and has managed international development projects in many other African nations.

More: <http://go.osu.edu/GUz>



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Omprakash Mittapalli co-authored the first-ever study of the genetic makeup of bed bugs. The research drew international attention. New control methods may result.

Without basic research to better understand bed bug biology and behavior, neither professionals nor ordinary Americans will have access to safe, effective, and affordable tools to combat these insects. The pest management industry is very fortunate for the research leadership The Ohio State University is providing, without which this epidemic will never be solved.”

— Bob Rosenberg, senior vice president, National Pest Management Association

THE ESSENTIALS

- The average family pays \$300–500 to get rid of bed bugs; the landlord of a large apartment building, \$50,000-plus; a hotel operator, \$250 to \$1,250 a room, plus the risk of lost business and lawsuits.
- A U.S. Centers for Disease Control and Prevention website says while an exact figure isn't known, the total economic losses from bed bugs — from health care, lost wages, lost revenue, and reduced productivity — are “substantial.”
- Jones, Mittapalli, and team's study came out early this year. CNN, NPR, ABC News, *Business Week*, and *The Wall Street Journal*, to name a few, all reported on the study.
- OARDC's advanced new Plant and Animal Agrosecurity Research (PAAR) Facility, which opened just this summer, will help make these studies even more robust.

OARDC a Leader in Bed Bug Science, Aim Is to Save U.S. Billions of Dollars

The national bed bug epidemic is costing homeowners and businesses, especially in tourism, billions of dollars every year, and Ohio is no exception.

Fortunately, thanks to the Ohio Agricultural Research and Development Center, the state is a leader in fighting the pest. OARDC scientist Susan Jones, who specializes in urban and household insect pests, studies how well bed bug insecticides, detectors, and other products work, serves on bed bug task forces in Columbus and Cincinnati, and has emerged as a national authority.

Also, Jones and another OARDC scientist, Omprakash Mittapalli, an expert on insect molecular biology, recently reported the first detailed study of bed bugs' genetic makeup. The scientists' work shows how the insects become resistant to common pesticides, a trait that makes killing the pests difficult and expensive. Knowing this, Mittapalli said, “could lead to novel methods of control that are more effective” — saving people and companies money, plus possibly spurring new products.

More: <http://go.osu.edu/GRK>



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Dan Herms (right) leads OARDC's efforts to control invading, tree-killing pests, such as the emerald ash borer. At stake? \$19 billion in economic impact and 340,000 jobs.

We don't know what our next bug will be, but we'll be ready and prepared having [Dan Herms and team's] research covering our flank. This is critical to Ohio and the United States, as we'll have more potential invasive pests with the global economy."

— Dave Bienemann,
municipal arborist,
City of Bowling Green

THE ESSENTIALS

- Ohio's nursery and landscape industry provides more than 240,000 jobs and has an economic impact of \$4 billion; Ohio's forest industry, 100,000 jobs and a \$15 billion economic impact.
- Damage from the emerald ash borer alone will exceed (or already has) \$20 million in lost nursery stock, \$1 billion in lost standing timber, and, in Ohio's communities, more than \$7 billion to remove and replace dead ash trees.
- New invaders include Asian long-horned beetle and hemlock woolly adelgid. Past examples include gypsy moth and Dutch elm disease.
- An emerald ash borer-resistant ash is being developed. Herms recently received a nearly \$1.5 million U.S. Department of Agriculture grant to continue that development.
- OARDC's advanced new Plant and Animal Agrosecurity Research (PAAR) Facility, which opened just this summer, will help make these studies even more robust.

Foreign Bugs Killing Ohio's Trees: Research Team Is Our Frontline Defense

Invasive tree-killing insects, such as the emerald ash borer, are costing Ohio's economy big. So scientists with the Ohio Agricultural Research and Development Center are working to fight them. Through ongoing research, entomologist Dan Herms and colleagues detect new invaders, track their spread, test ways to limit or eradicate them, and recommend steps to homeowners, businesses, and communities. Also a part of it: Developing improved varieties of trees that can stave off attack, leading to stronger replacements for what's been destroyed and potential new products for Ohio's \$4 billion nursery and landscape industry.

Herms and team's research "has helped our company grow and flourish in these challenging times," said Mark Webber, owner of a Dayton landscaping company and the 21-year host of a 100,000-listener radio gardening talk show (WHIO, Dayton). The team's findings, Webber said, "have helped us provide local Ohio employment and produce environmentally sound results for our clients."

More: <http://go.osu.edu/GQa> and <http://go.osu.edu/GQb>



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Nick Basta samples soil in Cleveland, which has the highest lead poisoning rate in the U.S. His new way to treat lead in soil costs far less than other options.

These are important issues for Ohio and the nation, and there's a need for sensible solutions. [Nick Basta's] research provides them. ... He has a drive to conduct excellent science."

— Kirk Scheckel, National Risk Management Research Laboratory, U.S. Environmental Protection Agency, Cincinnati

THE ESSENTIALS

- Children under 6 in greater Cleveland have the highest lead poisoning rate in the United States — nearly 1 out of 10, more than six times the national rate.
- Basta's method for treating lead in soil, using composts and similar materials, costs at least 75 percent less than the next most affordable remedy — about \$7,500 an acre instead of \$30,000.
- Cleveland alone has 3,000 acres of vacant lots, of which about 900 acres have lead levels requiring treatment to grow food. If the city were to treat them with Basta's method instead of the more expensive option, the savings would total at least \$20 million.
- Why tackle Lake Erie phosphorus? It feeds harmful algae blooms. Safe drinking water for 11 million people and the lake's more than \$1 billion tourism industry are at risk and will benefit.

Safer, Cleaner Soil and Water... and Saving Big Money in the Process

"The soil is the great connector of our lives," author Wendell Berry once said. Scientists with the Ohio Agricultural Research and Development Center continue their work to do good for all three — the soil, our lives, the connection. Soil chemist Nick Basta, for example, has developed a low-cost way to treat the lead that contaminates soil in our cities. (Lead in soil can make children sick and makes the land unfit for gardens.) His method is just a quarter the cost of the next most economical option — a big help for cash-strapped communities, especially ones ramping up urban farming.

Soil scientist Warren Dick is pioneering the use of flue-gas desulfurization (FGD) gypsum, a byproduct from Ohio's coal-fired power plants, to keep phosphorus in the soil, where we need it, and out of Lake Erie, where we don't. His work has the triple benefit of putting a waste to good use, improving the soil for crops, and cleaning up the lake, especially toxic algae blooms.

More: <http://go.osu.edu/GQg> and <http://go.osu.edu/GQh>



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Mary Gardiner leads a study looking at why honey bees and other vital pollinators are declining. Without pollination, many of our food crops would fail.

“People are concerned about honey bee decline, but they don’t know what to do. ... We support OARDC’s honey bee research because it will provide evidence on what’s actually happening and a scientific basis for how we can help.”

— Dwight Wells, DWQ Apiaries, Troy, and president, West Central Ohio Beekeepers Association

THE ESSENTIALS

- Experts say one out of every three bites of food we eat depends on pollination by honey bees.
- The value of honey bee pollination to U.S. agriculture is estimated at about \$15 billion.
- Honey bees pollinate 130 different food crops in the United States. Worldwide, the value of bee pollination to agriculture is put at \$217 billion. Some 100 crop species provide most of the world’s food, and bees pollinate 70 of them.
- In addition to pollination, honey bees provide, of course, honey, which in Ohio is about a \$2.4-million-a-year crop. Ohio beekeepers keep about 17,000 colonies, down from highs in the 1940s of more than 300,000.
- OARDC’s advanced new Plant and Animal Agrosecurity Research (PAAR) Facility, which opened just this summer, will help make these studies even more robust.

What’s Killing Bees, and How Can We Help Save Our Food Supply?

Ohio’s honey bee population has crashed, and scientists with the Ohio Agricultural Research and Development Center want to know why. Entomologists Mary Gardiner, Larry Phelan, and Scott Prajzner are investigating whether pesticide exposure is a culprit and, if so, where it’s coming from.

At stake is every third bite of food we eat, which is how much of our food supply needs bees for pollination. In the United States total, it’s a service worth \$9–15 billion.

“We’re comparing urban landscapes within the city of Cleveland, landscapes in Cleveland’s suburbs, and a diversity of agricultural landscapes in Wayne County,” Gardiner said. Their goal is to determine the risk within a honey bee’s “pasture”—the area in which the bee forages for pollen. It’s sometimes several square miles or more. Are bees getting toxins from farms, cities, suburbs, or some combination?

It’s a key first step to understanding the problem, developing science-based recommendations to cut the risk, and helping bees to recover.

More: <http://go.osu.edu/GQn> and <http://beehealthy.osu.edu/>



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- Some 230 scientists conducting more than 400 research projects annually.

OHIO AGRICULTURAL RESEARCH AND DEVELOPMENT CENTER

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Katrina Cornish leads a public-private partnership seeking to develop domestic sources of natural rubber from plants such as Russian dandelion and guayule.



“Growing demand for natural rubber could create supply issues in the mid- to long-term. Having a domestic source of natural rubber, such as TKS, potentially provides significant strategic and cost savings opportunities to Bridgestone. While we are in the very early stages of the evaluation of TKS-sourced natural rubber, early testing results have been encouraging.”

— Robert Handlos, Vice President for Research, Bridgestone Americas Center for Research & Technology

THE ESSENTIALS

- If Russian dandelion rubber were to reach an 8.4% share of the North American natural rubber market, it would generate at least 3,600 new jobs, with the first 250 expected by the end of 2014.
- The dandelion project's potential has attracted support from major players in the rubber and transportation sectors, including Bridgestone, Cooper Tire, Veyance Technologies, and Ford Motor Co. Ford plans to use dandelion rubber for interior car components.
- The Natural Fiber Composites Corporation (NFCC) established a 6-million-pound composite material plant in Wooster, with 12 jobs and \$3 million in revenue expected by the end of 2012.
- The two projects have received a combined \$6 million in funding from the Third Frontier program.

In Your House, In Your Car: OARDC Boosts Development of New Bioproducts

In collaboration with the Third Frontier-funded Ohio BioProducts Innovation Center (OBIC), the Ohio Agricultural Research and Development Center is partnering with industry to develop the next generation of biobased industrial materials that will go into the manufacturing of homes and vehicles — not to mention new Ohio businesses and jobs.

One example is natural rubber. Under the leadership of Katrina Cornish, endowed chair and Ohio Research Scholar in bioemergent materials, OARDC researchers are perfecting growing and extracting techniques for a rubber-producing plant that can be commercially produced in Ohio: Russian dandelion. OARDC will establish a pilot-scale processing plant in 2012 for solid rubber, latex, and film products. Also, Russian dandelion plantings have been significantly expanded to supply the processing plants.

OARDC and OBIC have also partnered with Columbus-based Natural Fiber Composites Corporation (NFCC), which manufactures biobased composite materials for construction, vehicles, and packaging reinforced with plant fibers instead of fiberglass. OARDC engineers helped the company perfect its feedstock and processing technology so it could reach production levels.

More: <http://go.osu.edu/GRZ> and <http://go.osu.edu/composites>



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Fred Michel tests the performance of cavitation units, generating crucial information for validation and adoption of this ethanol-boosting technology across the United States.

Dr. Michel and OARDC have brought to our team expertise we didn't have on the chemistry of ethanol and the challenges of cellulosic ethanol production; very sophisticated lab capabilities, equipment, and staff; testing procedures that are crucial for the success of this project; and the credibility that comes from having an unbiased academic perspective."

— Fred Clarke, executive vice president, Cleveland-based Arisdyne Systems Inc.

THE ESSENTIALS

- Arisdyne's technology is currently installed at four ethanol plants throughout the United States.
- A 3% increase in ethanol yield through cavitation can increase the revenue of a 100-million gallon ethanol plant by approximately \$3.75 million annually. If the entire U.S. ethanol industry (13.2 billion gallons in 2010) were to use cavitation, the revenue increase could reach at least \$500 million annually.
- Use of cavitation to improve access to cellulose available in corn could generate another 3–5% boost in ethanol production.
- The project has secured more than \$7.5 million in private equity funding, including out-of-state investments from California-based Chevron Technology Ventures and Georgia-based Cordova Ventures.
- Arisdyne has created 13 jobs as a result of this project.

New Technology Helps Boost Ethanol Production, Create New Jobs

The future of the U.S. ethanol industry depends on its ability to increase yields and be competitive with fossil fuels. The Ohio Agricultural Research and Development Center is collaborating with a Cleveland-based company to make that possible.

Thanks to a \$1 million Third Frontier grant awarded in 2008, Arisdyne Systems Inc. has developed a technology called controlled-flow cavitation, which allows ethanol plants to get more fuel from the same amount of corn. It accomplishes this by breaking open the cell structure of corn particles and releasing trapped starch molecules in the kernel — more starch means more sugar and, ultimately, more ethanol.

OARDC biosystems engineer Fred Michel has conducted testing to prove that Arisdyne's cavitation system can increase ethanol yield by roughly 2–3% — data critical to convince ethanol plants to test and adopt this new technology. Michel is also investigating new applications for cavitation, including cellulosic ethanol made from the non-edible parts of corn and other crops, such as wheat middlings.

More: <http://go.osu.edu/GQ7>



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Melvin Pascall's food packaging research is making food safer and allows it to last longer.

Dr. Pascall's research has great potential in the food packaging arena. His lab continues to assist my company in the development of new products that will be beneficial to the producer and consumer."

— Paul G. Tavella, President, Allevat Venture LLC

THE ESSENTIALS

Pascall also examines other advanced technologies, including:

- "Smart packaging," which detects changes in the environment and responds by changing its color or other properties to signal risks due to microbial contamination, temperature abuse, tampering, or other package defects. The use of nanotechnology increases the effectiveness of such packaging, providing much sharper changes in color when a signal is warranted.
- The use of antimicrobial compounds incorporated into packaging materials. Pascall found that coating butcher paper with silver zeolite particles significantly reduced the growth of bacteria on raw beef, pork, and turkey stored at 50 degrees F for up to four days. Using such products could reduce the risk of foodborne illness at food-service establishments, which often store cuts of raw meat on refrigerated, paper-lined trays before cooking.

Advanced Technologies in Food Packaging

Metal and glass food packaging is increasingly being replaced by plastic materials, but use is limited because plastic is porous to some types of gases. In a NASA-funded project, Melvin Pascall, a scientist at the Ohio Agricultural Research and Development Center, is examining the use of nanoparticles to develop new plastic food packaging materials that could be even lighter, cheaper to produce, and provide a better gas barrier.

"Nanoparticles can be fibers, sheets, or spheres that are no more than 100 nanometers in at least one dimension," Pascall said. A nanometer is one-billionth of a meter; the particles can be seen only through an electron microscope. Though small in measurement, nanoparticles can provide strong reinforcement for plastic packaging. So far, Pascall has improved the barrier properties of PET, a commonly used plastic food packaging, by 40 percent; in future studies, he hopes to double that figure. The end result would be higher quality packaging providing a longer shelf life at a lower cost.

More: <http://go.osu.edu/GVC>



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